THE GEOLOGY OF MIRANDA'S INVERNESS CORONA. E. J. Leonard[1], C. Beddingfield[2,3], C. M. Elder[1], T. A. Nordheim[1], R. J. Cartwright[2], C. Cochrane[1], and L. Regoli[4]. [1]Jet Propulsion Laboratory, California Institute of Technology (Erin.J.Leonard@jpl.nasa.gov), [2]SETI Institute, [3]NASA Ames Research Center, [4] John Hopkins University Applied Physics Laboratory, Baltimore, MD

Introduction: Miranda, a mid-sized icy moon of Uranus, has a surface made up of a patchwork of geologically old and young surface regions in the images returned by Voyager 2 [1]. The lack of impact structures in some regions suggest a period of relatively recent geologic activity (<1 Ga) [2]. Fractures, ridges, scarps, and a relative dearth of craters larger than about 10 km diameter, point to a history of significant tectonic resurfacing. This resurfacing is also evidenced by the coronae--three large (>200 km in diameter) ovoid to rectangular structures on Miranda's surface—in the limited images obtained by Voyager. Previous work on the coronae hypothesize that they formed through extensional tilt-block style tectonism and/or cryovolcanic processes [3, 4]. Here we seek to constrain potential formation mechanism for Inverness Corona, the youngest corona on Miranda [5]. By determining the formation mechanism for the most recent resurfacing on Miranda, we may be able to constrain the recent state of the ice-shell.

Understanding the formation of the coronae is critical to understanding Miranda's recent geologic past. Additionally, the dichotomy of Miranda's very young terrains directly adjacent to ancient ones is similar to Saturn's moon Enceladus [1, 6], which was found by the Cassini mission to be currently active [7, 8]. Such comparisons suggest Miranda could also be recently or currently geologically active and possibly harbors even more exciting features which will remain obscured until the next mission to the Uranian system.

Methodology: In order to investigate the formation of the coronae, we will first create a mosaic of all of the Voyager 2 imaging data of Miranda. We will then create a detailed geologic map of Inverness Corona and the surrounding region, and analyze the observations.

Mosaic Creation. The Voyager 2 spacecraft performed a flyby of Miranda while in the Uranian system in 1986. The Narrow Angle Camera (NAC) imaged Miranda at a range of resolutions with eight at a regional resolution (200-500 m/pixel). Here, we minimally process the images and mosaic them together to create a basemap for the geologic map. In order to align the images, we georeferenced each image in ArcGIS, centering the mosaic on the South Pole as defined by the originally controlled USGS product [9].

Geologic Map of Inverness Corona. After the completion of the image mosaic, we created a geologic map of the Inverness Corona region. Previous geologic maps of Miranda that include Inverness Corona [e.g., 1, 5, 10] are all at the global scale and not detailed enough for a thorough investigation into the potential formation mechanism. Thus, we will create a geologic map at the finest scale allowable by the resolution of the image, ~1:5M.

Table 1. Unit Names and Descriptions for Geologic Map of Inverness Corona

Unit Name	Unit Definition
Crater material (c)	Quasi-circular region with a raised rim and roughly bowl- shaped floors. May contain blocks or other slumped material.
Crater ejecta material (ce)	Region of relatively bright material surrounding some instances of crater material
Scarp material (s)	Smooth talus material with bright and dark striations apparently oriented downslope
Cratered plains material (cp)	Terrain consisting of smooth material, broken up by craters and the occasional broad ridge or scarp
Bright corona material (bc)	Material that appears bright compared to the surrounding terrain. Consists of a rough texture that may contain small pits or craters.
Inner corona material (ic)	Polygonal region made up of fine lineations (ridges or troughs near the limit of resolution) with a mottled brightness
Outer corona material (oc)	Polygonal region made up of fine lineations (ridges or troughs near the limit of resolution) with a uniform low relative brightness. Several scarps are also present.
Chasma material (ch)	Quasi-linear, topographically low region consisting of subparallel scarps and talus material in the low-laying areas.

The geologic units (Table 1) in our detailed geologic map include units based on the relative brightness of the terrain within the corona and the crater density and morphology outside of the corona. We also identify several linear features that are too small to be mapped as units at this scale. The linear features that we map

include Scarps, Troughs, and Ridges. We also map small (<2 km diameter) craters as point features.

Future Work: Following the completion of the geologic map of Inverness Corona, we have started working on sorting out the history of deformation in the region. In order to aid with the analysis, we will investigate feature topography using newly completed digital elevation models (DEMs) of the region from stereo-imaging and shape-from-shading (see Beddingfield abstract, LPSC 2022).

Initial observations of the stratigraphy of the geologic units show that, as expected, the cratered plains material is older than the corona material. Interestingly, at least some of the chasma material and scarp formation post-dates the formation of the outer corona material, evidenced by cross-cutting relationships in the northern part of the corona. Scarps and scarp material within the corona and outside the corona in the cratered plains appear to run sub-parallel to the edges of the corona, though these potential trends are an example of something we will explore quantitatively in the future.

Acknowledgments: Portions of this research were carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

References: [1] Smith, B. A. et al. (1986), *Science, 233*, pp. 43–64. [2] Zahnle et al., (2003), *Icarus, 163*, pp. 263–89. [3] Pappalardo et al. (1997), *JGR*, *102*, 13369-79. [4] Schenk et al. (1991), *JGR*, *96*, 1887-1906. [5] Croft and Soderblom (1991), *Uranus*, *U. A. Press*, 561-628. [[6] Beddingfield and Cartwright (2020), *Icarus* 343, 113687. [7] Porco et al. (2006), *Science*, *311*, 1393-1401 [8] Spencer et al. (2006), *Science*, *311*, 1401-1405. [9] Davies et al. (1987), *Icarus, 71*, 137-47. [10] Greenberg et al., (1991), *Uranus*, *U. A. Press*, 693-735.

Figure 1. Geologic map of Inverness Corona overlain on the new image mosaic. Note the legend in the upper right and the South Pole of Miranda in the lower right of the image.